



US005525980A

# United States Patent [19]

[11] Patent Number: **5,525,980**

Jahier et al.

[45] Date of Patent: **Jun. 11, 1996**

[54] **METHOD AND APPARATUS FOR OPERATING A CAPACITIVE TACTILE KEYBOARD**

4,441,097 4/1984 Anderson .  
4,550,221 10/1985 Mabusth .  
5,012,124 4/1991 Hollaway ..... 341/33

[75] Inventors: **Isabelle Jahier, Paris; Patrick Robert, Sartrouville, both of France**

### FOREIGN PATENT DOCUMENTS

2662528 11/1991 France .  
58-182746 10/1983 Japan .  
2138567 10/1984 United Kingdom .

[73] Assignee: **Sextant Avionique, France**

[21] Appl. No.: **49,345**

*Primary Examiner*—Edward L. Coles, Sr.  
*Assistant Examiner*—Thomas D. Lee  
*Attorney, Agent, or Firm*—Barnes & Thornburg

[22] Filed: **Apr. 21, 1993**

[30] **Foreign Application Priority Data**

[57] **ABSTRACT**

Apr. 24, 1992 [FR] France ..... 92-05088

[51] **Int. Cl.<sup>6</sup>** ..... **H03K 17/94; H03M 11/00**

[52] **U.S. Cl.** ..... **341/33; 341/22; 341/34**

[58] **Field of Search** ..... **341/20, 22, 24, 341/26, 33, 34; 345/173, 174; 200/600**

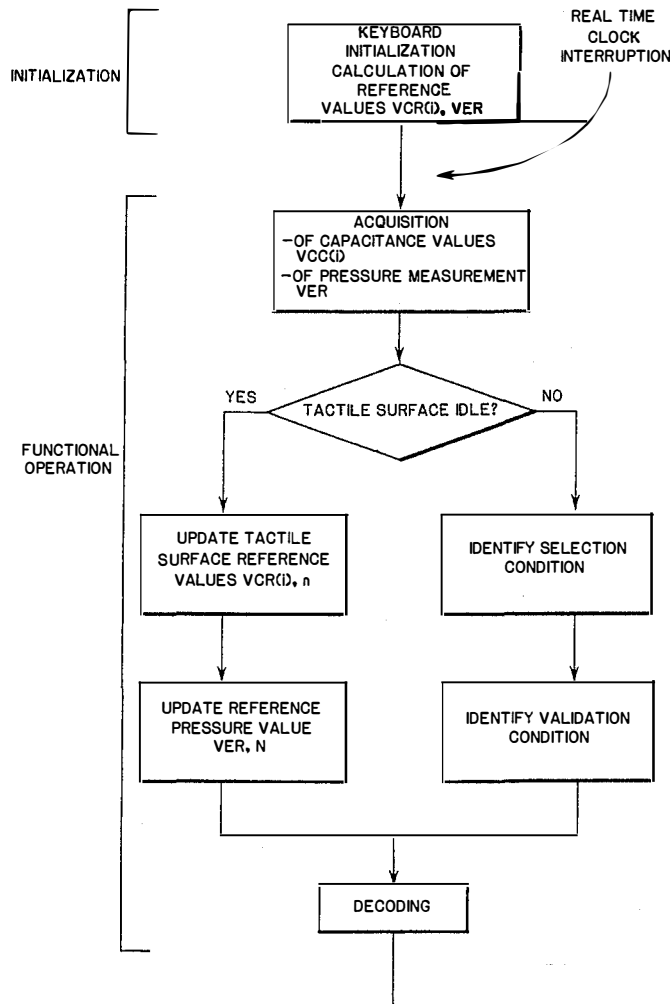
A method and apparatus for determining a valid selection of a capacitance tactile keyboard as a function of a selection state and validation state of the keyboard. The selection state is determined from measured capacitive values of each key by during a first phase of a cycle. The validation state is determined from measured pressure on the keyboard, for certain key selection states only, during a second phase of the cycle.

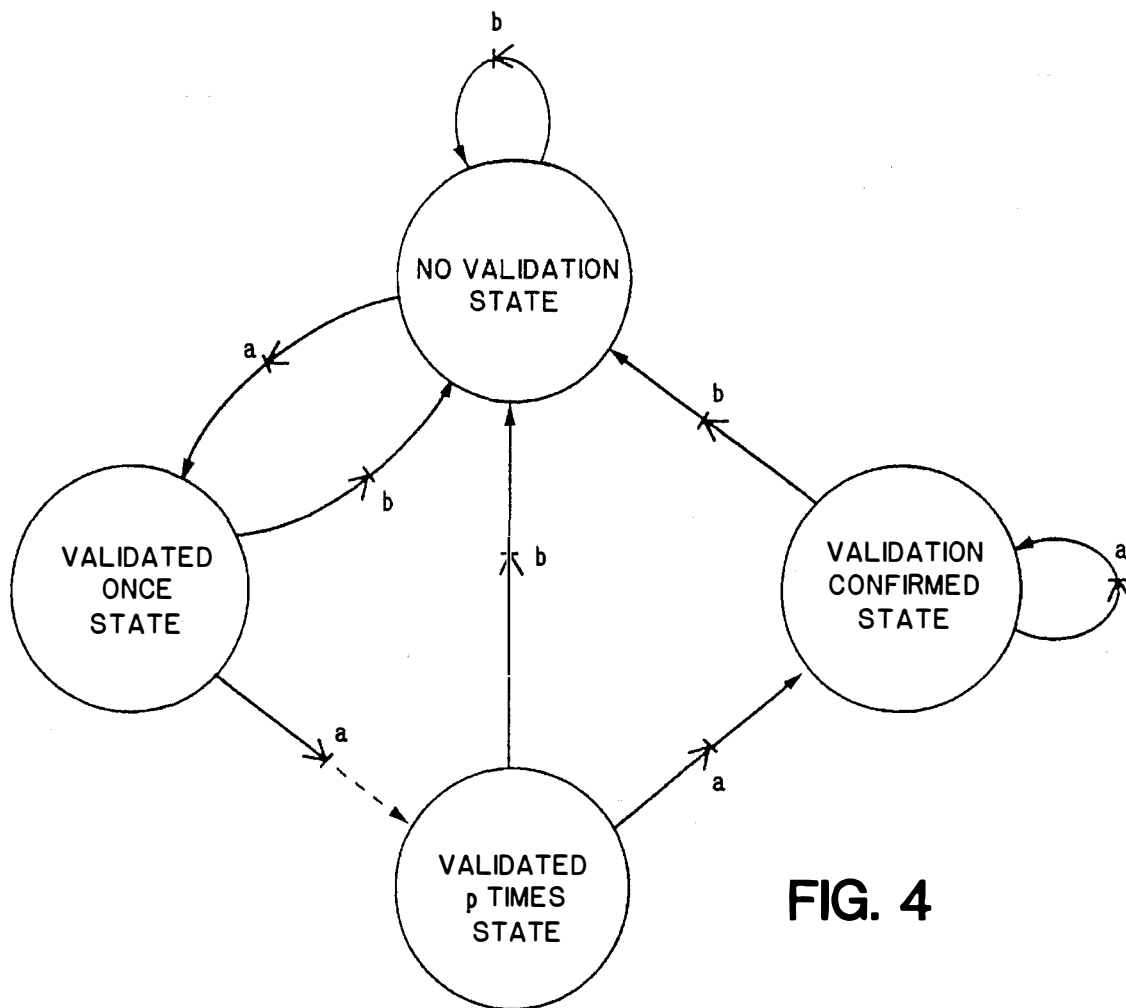
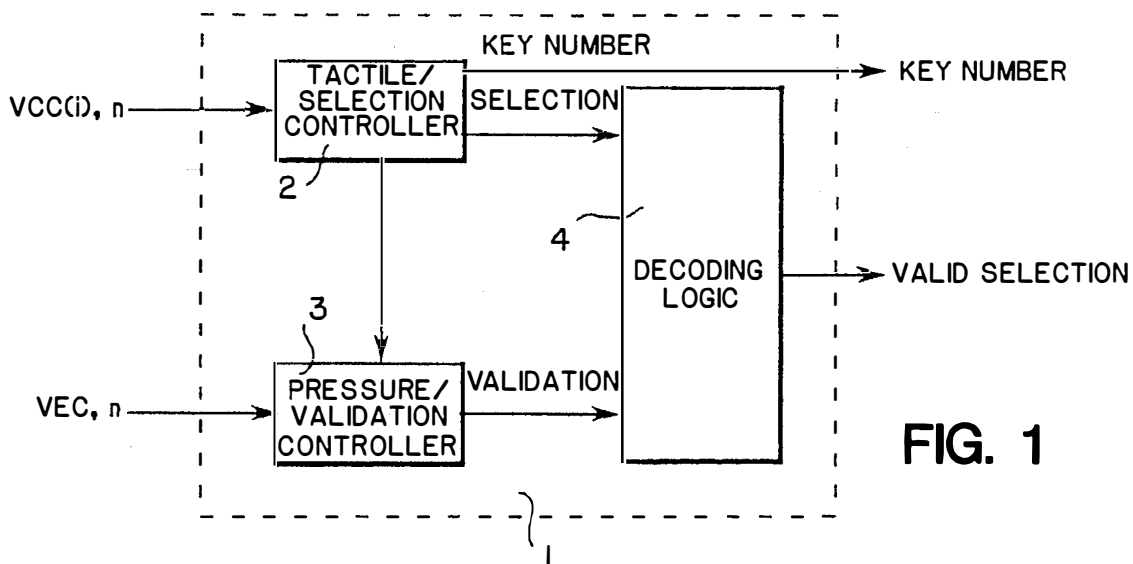
[56] **References Cited**

### U.S. PATENT DOCUMENTS

4,211,915 7/1980 Miller et al. .... 341/33

**21 Claims, 3 Drawing Sheets**





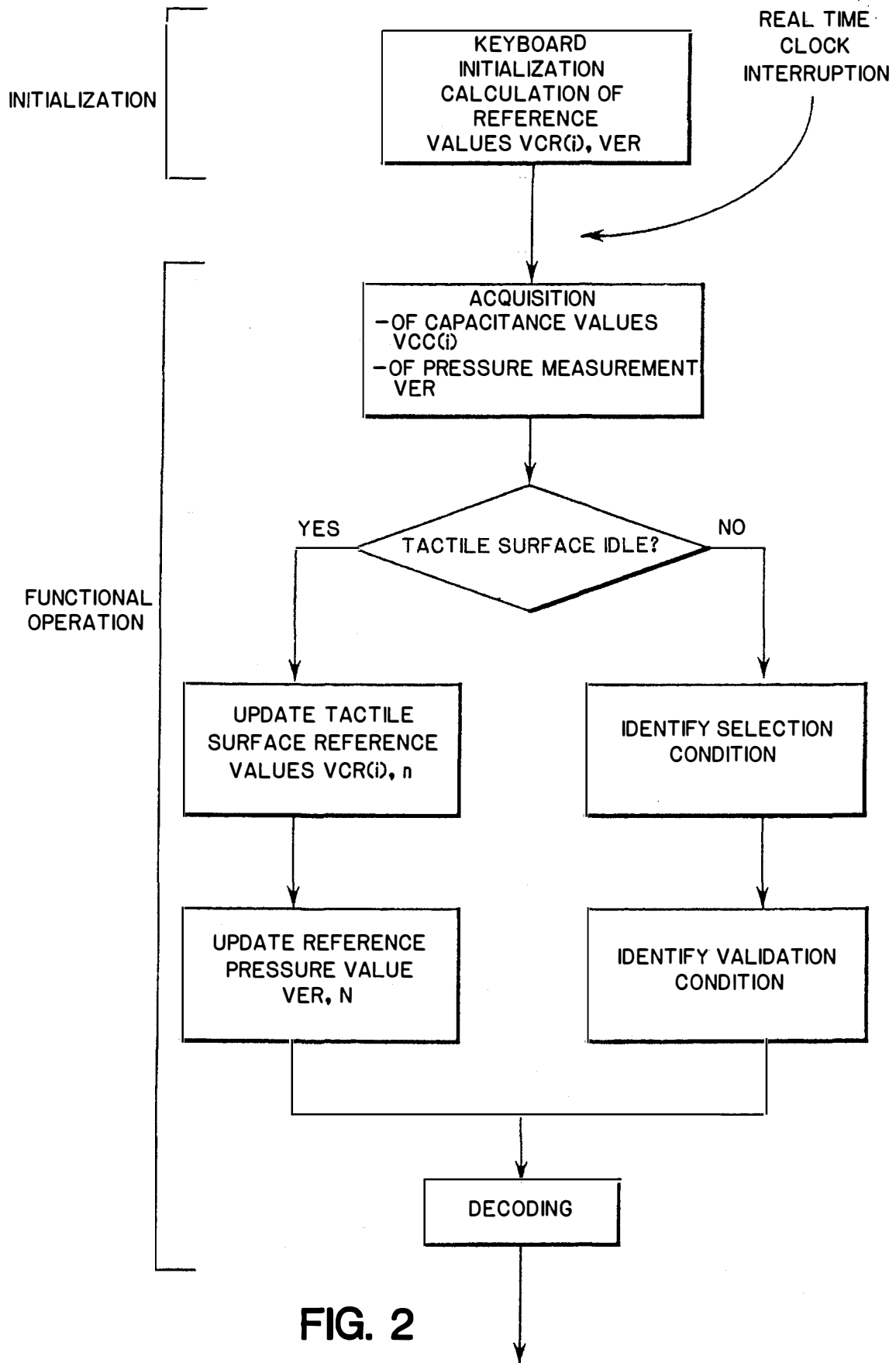
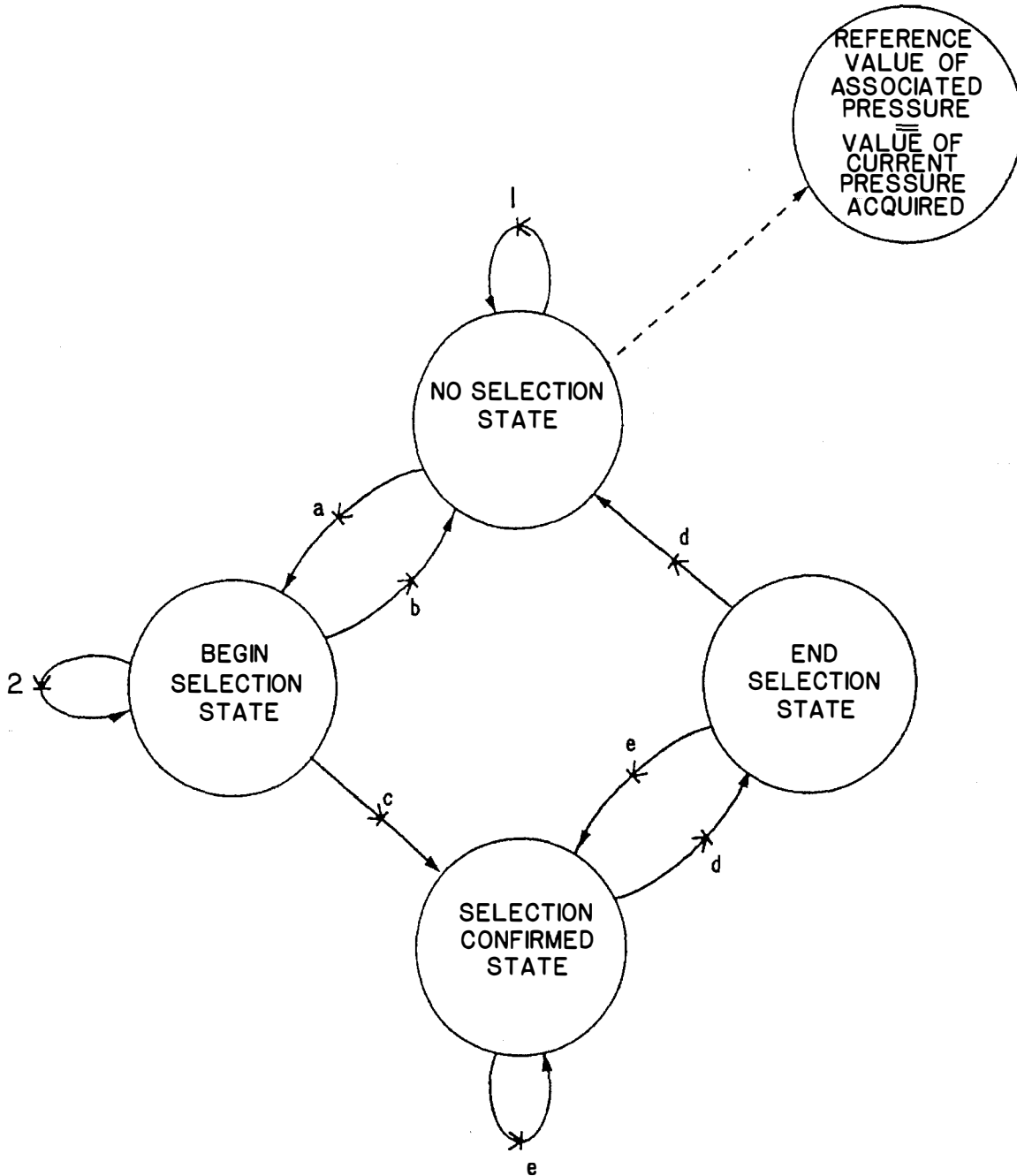


FIG. 2

FIG. 3



## METHOD AND APPARATUS FOR OPERATING A CAPACITIVE TACTILE KEYBOARD

### BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a method of apparatus for operating a capacitive tactile keyboard and, more particularly, to such a process wherein the position of the operator's finger on the keyboard and the pressure exerted by that finger are determined cyclically by measuring capacitance and pressure.

Such tactile keyboards are composed of a capacitive tactile surface positioned in front of a display, such as a liquid crystal display, for example, and make it possible to designate a specific area of the display by using a finger. To this end, the position of the finger on the surface is determined by capacitance measurements and the finger pressure exerted on the surface is detected by means of a pressure measuring device, consisting of resistance gauges, for example.

One object of the process according to the invention is to make it possible to use the signals generated by the capacitive tactile surface and the pressure measurement device.

Another object is to provide a fully programmable parameter keyboard designed to meet the requirements of operating applications and environmental constraints.

A still further object is to provide for the adjustment of keyboard sensitivity and to compensate for drifts and interference.

To this end, the object of the invention is a device for operating a capacitive tactile keyboard wherein the position of the operator's finger on the keyboard and the pressure exerted by that finger are determined cyclically by capacitance measurements and pressure measurements, characterized in that:

during a first phase of each cycle, the capacitance value of each key on the keyboard is measured and a keyboard selection state is defined based on these measurements; during a second phase of the cycle, for certain keyboard selection states only, the pressure measurements are taken into account to define a keyboard validation state; and

a decision is made on whether a valid selection has occurred as a function of the selection state and the validation state of the keyboard.

The process according to the invention is implemented by two controllers operating in a master/slave relationship and by a decoding logic.

The first controller is associated with the capacitance measuring device. Its input parameters are analog and are composed of the capacitance measurements at each cycle for each key of the keyboard, and its output parameters consist of a positive integer characterizing the selected key and a logic parameter defining the selection state of this key.

The second controller is associated with the pressure measuring device. Its input parameter is also analog and consists of the value of the pressure measured at each cycle; and its output parameter is the logic parameter defining the validation state.

The two logic parameters of the two controllers, selection and validation, are applied at the input of the decoding logic, which generates a valid selection logic parameter at its

To adjust for drifts and interference due to environmental factors, means may be provided for comparing the measured capacitance and pressure values to reference values and, if all measured differences in capacitance are less than a predefined low threshold, for updating the reference values.

Consequently, as long as the measured differences in capacitance are less than the low threshold, the keyboard is considered to be idle and the differences in both the capacitance values and the pressure values are considered to be attributable to drift or interference. In this case, both reference values are modified or updated. Conversely, as soon as the difference in capacitance is greater than or equal to the aforesaid low threshold, this difference is considered to be due to actuation of the keyboard, and the corresponding reference capacitance value and reference pressure value are no longer updated.

In a particular embodiment of the process of the invention, the updated reference capacitance value is obtained by calculating a weighted average using at least the previously calculated average and the measured capacitance value, and the updated reference pressure value is the last measured pressure value.

The updated reference capacitance value is obtained by calculating a weighted average from at least the previously calculated average and the measured capacitance value and therefore depend not only on currently measured capacitance values, but also on capacitance values measured during at least one preceding cycle. By weighing the current capacitive values when calculating the reference capacitive value, sensitivity can be adjusted to compensate for drift and interference, mainly of electrical origin.

Conversely, the updated reference pressure value is the current pressure value which has just been measured. This is possible because this pressure value is not in any event updated until the measured differences in capacitance are less than the low threshold and, consequently, until the keyboard is idle. This arrangement makes it possible to overcome the load factor problem.

In one particular embodiment of the invention, the differences between the measured capacitance values and the reference capacitance values are calculated. The keyboard has at least one non-selection state, one pre-selection state, and one confirmed selection state. Also, the transitions from one state to another are determined by comparing the differences in capacitance to a low threshold and to a high threshold.

More particularly, a key may be preselected when its difference in capacitance is greater than the low threshold, and a key may be selected if it has already been preselected and its difference in capacitance is greater than the high threshold.

Measurements may also be made for sorting from among several keys that are likely to be preselected, to manage conflicts, and to compensate for inadvertently brushing against the keyboard.

More particularly, when the difference in capacitance between two keys is greater than their low threshold, it is possible to preselect only the key with the highest difference in capacitance.

Moreover, when the keyboard is in the idle state or when a key has already been preselected, the keyboard remains or returns to the non-selection state if the difference in capacitance of at least two keys is or was greater than the high threshold, respectively.

Finally, when one, and only one, non-preselected key has a difference in capacitance greater than the high threshold,

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.